Thermophysical Properties of Foamcokes and Intumescent Coatings of Modified Carbon Metal Containing Tubules

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Epoxy resin ED-20 containing ammonium polyphosphate (APP), phenanthrene dehydropolycondensation products containing chromium and nickel (tubulene T - Cr, Ni, Mn), calcium borate and/or manganese oxide are used to investigate thermophysical properties of intumescent coatings modified by phosphorus-metal containing cluster systems. It is found that cylindrical micro- and nanostructures (tubulenes) are formed during phenanthrene dehydropolycondensation and stimulated carbonization in the presence of chromium salts. The epoxy resin is cured by polyethylenepolyamine. While studying the temperature dependence of the thermal capacity of intumescent compositions, it is determined that thermal capacity increases with temperature and reaches maxima at 150 ºC and 300 ºC. The temperature dependence of the thermal capacity of intumescent composition surface correlates with analogous thermal capacity dependence. The extrema are explained by physicochemical processes proceeding during foamcoke formation. Surface and boundary layers (split surface) of both the cured epoxy resin and pyrolysis residues are investigated by X-ray photoelectron spectroscopy (XPES). When the sample is heated to the temperature of the beginning of pyrolysis (260 ºC), the egress of phosphorus-containing groups onto the sample surface is registered. This is proved by the increase of phosphorus concentration on the surface as well as by the intensity distribution of nitrogen, carbon and oxygen 1s lines in the X-ray photoelectron spectrum. When the temperature in the boundary layers increases, the decrease of the relative quantity of C-OR and carboxyl groups is registered; this proves the carbonized layer growth. The determination of combustibility of intumescent coatings by UL-94 type shows that all of them are classified by V-O group. Thus, phosphorus-nitrogen and phosphorus-boron containing fire-retardant intumescent coatings, which comprise carbon-metal containing tubulenes forming strong foamcokes with high fire- and thermal-resistant properties, are produced and investigated.

References

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